EXECUTIVE SUMMARY[1]

I. INTRODUCTION

On September 20, 1991, the Occupational Safety and Health Administration (OSHA) published a Request for Information (RFI) concerning "Occupational Exposure to Indoor Air Pollutants" in the Federal Register. 56 Fed. Reg. 47892 et seq. (1991). The stated purpose of this RFI is to gather data so that OSHA could determine "whether regulatory action is appropriate and feasible to control health problems related to poor indoor air quality." 56 Fed. Reg. 47892 (1991). In examining this central issue, OSHA has requested information concerning the health effects of poor indoor air quality, ventilation system performance, and "specific indoor contaminants such as passive tobacco smoke (PTS), radon and bioaerosols" and "their relative contribution to the overall degradation of indoor air quality as well as associated health effects and methods of exposure assessment and mitigation." 56 Fed. Reg. 47892 (1991).

Despite the Agency's stated central objective of examining all aspects of indoor air quality in determining whether

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1. This portion of the Philip Morris submission to Docket No. H-122 is intended only to summarize some of the critical points more fully discussed in its specific responses to the individual Request for Information inquiries. References within this Executive Summary are to the full text of the Company's responses to those individual questions.

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regulatory activity is warranted, we anticipate that a number of individuals and organizations will use the comment mechanism solely as a forum to vent their objections to passive tobacco smoke. This limited focus ignores significant contributors to indoor air quality problems and, in effect, argues that a ban on PTS will "solve the indoor air quality issue." As will be outlined in this summary and addressed fully in the appended substantive responses to the RFI inquiries, the relevant studies that have examined the role played by PTS on indoor air quality in the workplace environment have demonstrated that this role is minimal.

II. THE ROLE OF PASSIVE TOBACCO SMOKE IN INDOOR AIR QUALITY

A. Distinguishing PTS from Other Types of Tobacco Smoke

Before reviewing the scientific literature on "sick building syndrome" and the epidemiologic studies on health effects claimed to be associated with various substances (including PTS) found in many workplace indoor air environments, it is important that a clear understanding exist about the differences among (1) passive tobacco smoke (PTS) (often referred to in the literature as "environmental tobacco smoke" or "ETS"), (2) sidestream smoke (SS), and (3) mainstream smoke (MS). As discussed below, PTS is different in both quality and quantity from MS and SS.

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PTS is an aged and dilute mixture of sidestream smoke (the smoke from the burning end of a cigarette) and exhaled mainstream smoke (the smoke to which the smoker is exposed). PTS, a dynamic, ever-changing mixture which dissipates and undergoes chemical reactions and physical change as it ages, differs both chemically and physically from MS and SS. There is no single definable, reproducibly characterizable entity known as PTS.[2]

Studies indicate that PTS constituents are hundreds to thousands of times more dilute than either SS or MS. As a result, concentrations of PTS constituents often fall below detection limits of current scientific measurement techniques. (See Responses to Questions 2a(iii) and 35.) In addition, as PTS ages, a number of physical and chemical changes take place. As they age, matter evaporates from PTS particles, the particles also coagulate and increase in size, and chemical compounds transfer between the gas and particle phase of the smoke. Decay patterns for constituents of PTS vary over time and are dependent upon physical conditions in the environment.

PTS is not equivalent to either SS or MS. Yet, many studies employ sidestream/mainstream smoke comparisons, ostensibly to demonstrate the kind and quantity of constituents involved in

2. Baker, R. and Proctor, C., "The Origins and Properties of Environmental Tobacco Smoke," Environ. Intl. (16): 231-245, 1990.

exposure to PTS. These comparisons are misleading. (See Response to Question 2a(iii).) As was conceded in the 1986 National Academy of Sciences/National Research Council Report on PTS:

> Because the physicochemical nature of ETS, MS, and SS differ, the extrapolation of health effects from studies of MS or of active smokers to nonsmokers exposed to ETS may not be appropriate.[3]

B. PTS and Sick Building Syndrome

"Sick building syndrome" is generally characterized by a number of non-specific complaints which building occupants relate to conditions (usually the air quality) in the building. These complaints include headaches, nausea, coughs, sore eyes and breathing difficulties. Given the visibility of PTS, it is often initially identified as the cause of these complaints and symptoms. Its presence, however, is frequently an indication of poor ventilation, which results in the accumulation of many other indoor air components that may actually be associated with adverse effects. A review of a large number of actual "sick building" investigations reveals that PTS is correlated with complaints in only two to five percent of all sick buildings investigated.

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3. Committee on Passive Smoking, Board of Environmental Studies and Toxicology, National Research Council, National Academy of Sciences, Environmental Tobacco Smoke, Measuring Exposures and Assessing Health Effects, National Academy Press, Washington, D.C.: 7-8, 1986.

Specifically, analysis of three large databases on sick building syndrome investigations, including databases from Health and Welfare Canada, T.D. Sterling Ltd., and Healthy Buildings International, reveals no significant correlations between IAQ complaints and specific agents. These results are consistent with the sick building investigations conducted by the National Institute of Occupational Safety and Health (NIOSH). In a review of 203 air quality investigations of schools, health care facilities, and government and business offices, NIOSH concluded that tobacco smoke played a contributing role in only 4 (2%) of the building complaints investigated.[4]

In over 50 percent of the sick building cases contained in the above referenced databases, many symptoms and complaints presumably could have been abated by increasing ventilation rates to those comparable to the rates specified in ASHRAE 62-1989. NIOSH officials recently reported on an additional 326 building investigations conducted by the Agency through 1988. Again, consistent with the other public and private databases, NIOSH reported that over 50 percent of its investigations revealed inadequate ventilation as the source of complaints. (See Response to Question 3a.)

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4. Melius, J., et al., "Indoor Air Quality -- the NIOSH Experience," Ann. Am. Conf. Gov. Ind. Hyg., Vol. 10 : 3-7 (1984).

C. The Scientific Literature on PTS[5]

In the "Background" section of the RFI, OSHA states that workplace exposure to passive tobacco smoke is a "particular concern in matters dealing with indoor air quality" and asserts that:

> A wide range of health effects caused by passive exposure to tobacco smoke has been reported by the Surgeon General, the National Research Council, the Environmental Protection Agency (EPA), and private researchers, as well as by persons reporting health effects due to exposure to passive smoke while at work. These effects range from acute annoyance and eye and respiratory tract irritation to the development of chronic pulmonary disease, cardiovascular disease, and lung cancer.
>
> 56 Fed. Reg. 47892 (1991).

Contrary to the above assertions about the purported health effects of exposure to PTS in the workplace, the available data from published epidemiologic studies are not sufficient to

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5. In an attached document, Philip Morris has responded specifically to the 1986 Surgeon General's report on The Health Consequences of Involuntary Smoking, the Environmental Protection Agency's Draft Risk Assessment, Health Effects of Passive Smoking : Assessment of Lung Cancer in Adults and Respiratory Disorders in Children, the National Institute for Occupational Safety and Health's Current Intelligence Bulletin, Environmental Tobacco Smoke in the Workplace: Lung Cancer and Other Health Effects and several published risk assessments on PTS.

support the claim that PTS exposure in the workplace is associated with chronic disease in nonsmokers. A primary deficiency in these studies is the lack of reliable exposure data. Published epidemiologic studies which report an association between spousal or parental smoking and chronic disease (e.g., lung cancer, heart disease, etc.) in nonsmokers are not based on actual exposure assessments for PTS. Instead, these studies rely on subjective responses to questionnaires to assess "exposure" rather than on any quantifiable measurement. For example, questionnaire inquiries regarding "spousal smoking," "parental smoking," or "living with a smoker" are used as surrogate determinants for PTS exposure in these studies. Numerous recent studies indicate, however, that such subjective assessments are an extremely unreliable and inaccurate measure of exposure. Furthermore, these questionnaire responses about exposure often vary widely when compared with actual measurements of PTS constituents in the ambient air. (See Response to Question 2a(iii).)

Actual data on nonsmoker exposure to PTS are available in other published literature. These studies, which measure PTS constituent levels, indicate that nonsmoker exposure to PTS under realistic conditions in public places and workplaces is minimal. For example, researchers report little difference in the ambient levels of carbon monoxide or volatile organic compounds in smoking and nonsmoking areas of workplaces and public places, or in homes

with and without smokers.[6] In other studies, typical measurements of nicotine range from an exposure equivalent of 1/100 to less than 1/1,000 of one filter cigarette per hour.[7] (See Response to

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6. Kirk, P., et al., "Environmental Tobacco Smoke in Indoor Air." In: Indoor and Ambient Air Quality. R. Perry and P. Kirk (eds.). London, Selper Ltd., 99-112, 1988.

   Duncan, D. and Greavey, P., "Passive Smoking and Uptake of Carbon Monoxide in Flight Attendants," JAMA 251(20): 120-21, 1984.

   Cox, B. and Whichelow, M., "Carbon Monoxide Levels in the Breath of Smokers and Nonsmokers: Effect of Domestic Heating Systems," J Epidemiol Community Health 39: 75-78, 1985.

   Girman, J. and Traynor, G., "Indoor Concentrations," JAPCA 33(2): 89, 1983.

   Yocom, J., "Indoor Concentrations," JAPCA 33(2): 89, 1983.

   Nitta, H., et al., "Measurements of Indoor Carbon Monoxide Levels Using Passive Samplers in Korea." In: Indoor Air '90. The Fifth International Conference on Indoor Air Quality and Climate, Toronto, Canada, July 29-August 3, 77-82, 1990.

   Bayer, C. and Black, M., "Thermal Desorption/Gas Chromatographic/Mass Spectrometric Analysis of Volatile Organic Compounds in the Offices of Smokers and Nonsmokers," Biomed and Envir Mass Spect 14(8): 363-367, 1987.

   Proctor, C., et al., "Measurements of Environmental Tobacco Smoke in an Air-Conditioned Office Building," Environ Technol Letters (10): 1003-1018, 1989.

   Godish, T., "Formaldehyde Exposures from Tobacco Smoke: A Review," AJPH 79(8): 1044-1045, 1989.

   Godish, T., "Residential Formaldehyde: Increased Exposure Levels Aggravate Adverse Health Effects," Journal of Environmental Health 53(3): 34-35, 1990.

7. Hinds, W. and First, M., "Concentrations of Nicotine and Tobacco Smoke in Public Places," New England Journal of Medicine 292(16): 844-845, 1975.

(continued...)

Questions 2a(iii), 24 and 35.) This means that a nonsmoker would have to spend from 100 to 1,000 hours or more in a workplace where smoking was permitted in order to be exposed to the nicotine equivalent of smoking a single cigarette.

D. Health Effects Purportedly Associated with PTS

It is asserted in the Request for Information that the health effects purportedly associated with PTS range from "acute

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7.(...continued)

Badre, R., et al., "Pollution Atmospherique par la Fumee de Tabac (Atmospheric Pollution by Smoking)," Ann Pharm Fr 36(9-10): 443-452, 1978. Translation.

Jenkins, R., et al., "Development and Application of a Thermal Desorption-Based Method for the Determination of Nicotine in Indoor Environments." In: Indoor and Ambient Air Quality. R. Perry and P. Kirk (eds.). London, Selper Ltd., 557-566, 1988.

Muramatsu, M., et al., "Estimation of Personal Exposure to Tobacco Smoke with a Newly Developed Nicotine Personal Monitor," Environ Res 35: 218-227, 1984.

Muramatsu, M., et al., "Estimation of Personal Exposure to Ambient Nicotine in Daily Environment," Arch Occup Environ Health 59: 545-550, 1987.

Thompson, C., et al., "A Thermal Desorption Method for the Determination of Nicotine in Indoor Environments," Envir Sci Tech 23: 429-435, 1989.

Foliart, D., et al., "Passive Absorption of Nicotine in Airline Flight Attendants," New England Journal of Medicine 308(18): 1105, 1983.

Oldaker, G. and Conrad, F., "Estimation of the Effect of Environmental Tobacco Smoke on Air Quality Within Passenger Cabins of Commercial Aircraft," Envir Sci Tech 21: 994-999, 1987.

annoyance and eye irritation to the development of chronic pulmonary disease, cardiovascular disease and lung disease." We contend that the published research does not support this assertion.

1. Lung Cancer

The argument that PTS exposure increases the risk of lung cancer in nonsmokers is based on data from epidemiologic studies of nonsmoking women married to smokers (spousal smoking). Of the 30 published epidemiologic studies on the issue of spousal smoking and lung cancer, none actually measured exposure to PTS. Twenty-four of the 30 studies report results which are not statistically significant -- that is, their conclusions were consistent with the null hypothesis of no association between reported exposure to PTS and lung cancer in nonsmokers.[8] Only 12 of the published

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8. Despite the inconclusive nature of the epidemiologic data on spousal smoking, several risk assessments estimating excess lung cancer mortality purportedly due to PTS have appeared recently in the published literature. Two approaches have been used. The first attempts to extrapolate risks for the general nonsmoking population based upon the risk rates reported in epidemiologic studies on spousal smoking. One such risk assessment has estimated that as many as 5,000 deaths per year can be attributed to PTS exposure among nonsmokers in the U.S. The second approach estimates a risk for nonsmokers which is based upon the reported dose of tobacco smoke for active smokers.

Risk assessment models which are based upon dose-extrapolation from the active smoker disregard the physico-chemical differences between mainstream smoke and PTS. This approach also assumes the applicability of linear extrapolation from active smoking to very low estimates of PTS exposure and dose (continued...)

spousal studies have assessed reported workplace exposures to PTS at all, but again no actual measurements were conducted. Ten of the 12 workplace studies report associations between PTS and nonsmoker lung cancer which do not achieve statistical significance. Only two studies report marginally statistically significant increased risks for persons who reported exposure to PTS in the workplace. (See Response to Question 2a(iii).)

2. Heart Disease

There are no studies in the published literature which have examined actual PTS exposures in the workplace and heart disease in nonsmokers. Only twelve epidemiologic studies on spousal smoking in the home and heart disease in nonsmokers are available. These studies, based on marriage to a smoker, are not relevant to

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8.(...continued)
for nonsmokers. Dose-extrapolation models which employ unrealistically high estimates of PTS exposure for nonsmokers nevertheless generate mortality projections which are at least an order of magnitude lower than estimates from the epidemiologic-based models. Dose-extrapolation models which are based upon realistic exposure levels of PTS for nonsmokers from actual constituent monitoring studies in homes, public places and the workplace have failed to predict any significant increased risk for nonsmokers.

Both approaches have been criticized extensively in the published literature. In particular, both assessments assume a causal connection between PTS exposure and lung cancer in nonsmokers. Moreover, the risk assessment models which are based upon epidemiologic studies accept uncritically the relative risks reported in studies on spousal smoking. The approach also assumes, without foundation, that these reported risks are attributable solely to PTS.

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the workplace issue. In addition, the spousal smoking studies on heart disease contain no data on actual exposures to PTS. Instead, exposure estimates are derived from questionnaire responses.

Nonetheless, five of the 12 published epidemiologic studies on spousal smoking and heart disease did attempt to address workplace exposures to PTS. However, none of the five studies reported a statistically significant increased risk of heart disease among nonsmokers claiming exposure to PTS in the workplace. Thus, the existing literature does not provide support for the claim that PTS exposure in the workplace is related to an increase in risk of heart disease among nonsmokers.

3. Respiratory Disease Other than Cancer/Asthma

Relatively few studies have examined the possible relationship between reported exposure to PTS in the workplace and the respiratory health of nonsmoking adults. The studies that have been conducted on this issue reported contradictory results. Researchers who have reviewed these studies cited problems with the methodology utilized and pointed out that confounding factors are not adequately controlled for in the studies. (See Response to Question 2a(iii).)

Data on the possible association between exposure and increased risk of an asthmatic reaction are similarly contradictory. There are nine major studies on the possible association between exposure to PTS and acute respiratory symptoms in adult asthmatics. The studies are inconsistent in their reported results which range from reported decreases in pulmonary function of several asthmatics exposed to PTS to conclusions that PTS exposures present no acute respiratory risks to asthmatics. The studies that do report an association between adult asthma and exposure to PTS suffer from several methodological flaws that include: (1) confounding factors that are not adequately controlled for in many studies; (2) inadequate sample sizes; (3) psychological factors that have not been ruled out; and, (4) reliance on unrealistic exposure conditions in enclosed smog chambers. (See Response to Question 2a(iii).)

III. SOURCES OF INDOOR AIR POLLUTION

PTS receives significant public attention because of its visibility in the indoor environment. However, as discussed above, the role of PTS in the make-up of the overall indoor air quality environment is minimal. In fact, in the RFI itself, OSHA has recognized that a myriad of specific airborne substances in indoor workplaces, often interacting with one another, result in health complaints related to indoor air quality. In many cases, investigations of these complaints have revealed exposure levels

of the various constituents in indoor air well below established OSHA permissible exposure limits. Perhaps most notably, statistics cited in the RFI from approximately 500 NIOSH Health Hazard Evaluations reveal that while indoor air quality complaints result from numerous airborne substances, the source of most complaints is "inadequate ventilation." The primary types of indoor air quality problems encountered in these investigations were categorized as:

> inadequate ventilation (52%); contamination from inside the building (17%); contamination from outside the building (11%); microbiological contamination (5%); contamination from building materials and furnishings (3%) and unknown sources (12%).
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> 56 Fed. Reg. 47892 (1991).

In its more detailed study of 203 of these investigations (1984), NIOSH reported that tobacco smoke was a contributing factor in only four (2%) of the buildings investigated. In a 1989 follow-up report of over 500 building investigations, NIOSH did not elect to even designate PTS as a separate category* of contributing factors.[9]

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9. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Division of Standards Development and Technology Transfer, "The NIOSH Approach to Conducting Indoor Air Quality Investigations in Office Buildings," Indoor Air Quality Selected References, September, 1989.

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A. Chemical Agents

There is a large body of scientific literature which suggests that exposure to significant levels of chemical agents in the indoor air environment, such as formaldehyde, carbon monoxide, nitrogen dioxide and carbon dioxide, is associated with complaints about adverse health effects. Organic chemical agents, including volatile organic compounds (VOCs), have specifically been implicated as contributors to indoor air complaints. For example, exposure to formaldehyde, which offgasses from some building products, has been associated with irritation of the eyes, skin, and the respiratory tract and has been designated a potential carcinogen in humans. The literature further suggests that exposure to other VOCs has similarly been associated with symptoms of sick building syndrome, such as headaches, dizziness, fatigue, eye, nose and throat irritation, and possibly decreased immunity. Scientists have also reported that there are synergistic reactions that possibly occur between significant levels of different chemical agents in the indoor environment, and that attempts to control individual sources of chemical agents may not be sufficient to prevent this potential combined effect. Moreover, specific VOC levels have been associated with specific health complaints from occupants of buildings with inadequate ventilation. (See Response to Questions 2a(i) and 26a.)

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B. Bioaerosols

In 1984, the New York Academy of Medicine drafted a resolution on indoor air pollution in which they stated:

> By far the most important substances in indoor air that affect human health are infectious agents, primarily viruses and bacteria, in the form of aerosols or as a part of droplets or particles. These cause more than 60,000 deaths and 250 million disabling illnesses in the United States each year. Their effects upon health are many times greater than that of all other indoor air pollutants.[10]

Bioaerosols are biological agents such as viruses, bacteria, mold spores, and fungi. In the indoor environment, the typical health effects associated with bioaerosols are infectious respiratory diseases such as Legionnaires' disease, Pontiac Fever, colds and influenza, and other conditions including hypersensitivity pneumonitis, humidifier fever, asthma, and sick building syndrome. The incidence of many of these illnesses has been linked to improper maintenance of ventilation systems or to inadequate levels of air exchange. For instance, Legionella pneumophila, the organism responsible for Legionnaires' disease, a form of severe, sometimes

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10. Committee on Public Health, New York Academy of Medicine, "Resolution Concerning Federal Legislation and Research on Indoor Air Pollution," Bulletin of the New York Academy of Medicine, 60 : 106-109, 1984.

fatal pneumonia, has been isolated in water from ventilation systems. Publicly available statistics indicate that a substantial portion (as much as 40%) of buildings may have biological contamination. (See Response to Questions 2a(ii), 5b and 33a.)

C. <u>Radon</u>

Radon is a naturally occurring radioactive gas that is present in both outdoor and indoor environments. Radon is produced by the radioactive decay (breakdown) of uranium. Radon itself decays and produces "progeny" or "daughters," which along with the actual radon, can be inhaled. Epidemiologic studies report an increased risk of lung cancer associated with the inhalation of radon and radon progeny in underground miners. Based on extrapolation from the miner studies, it has been suggested that radon exposure may be responsible for 10-20% of the attributable lifetime lung cancer risk in the general population. Therefore, radon is a major mitigation concern for building owners. (See Response to Question 2a(iv).)

IV. <u>EFFECTIVE VENTILATION AND INDOOR AIR QUALITY</u>

One of the responses to the energy crisis of the 1970s was to reduce the volume of outside air introduced into buildings through their ventilation systems. Although this measure served a

useful energy conservation purpose, it had the unintended consequence of increasing the incidence of health-related complaints associated with indoor air quality. As specifically noted in the "Background" section of the RFI, OSHA itself has recognized that "[h]ealth complaints related to indoor air quality . . . increased significantly following energy conservation measures instituted in the early seventies. Such measures have generally reduced the infiltration of outside air, allowing the build-up of indoor air contaminants." As discussed above, OSHA has further recognized that of the approximately 500 Health Hazard Evaluations for indoor air quality conducted by NIOSH over the past decade, 52% of the problems encountered were categorized as being due to inadequate ventilation. 56 Fed. Reg. 47892 (1991).

If OSHA determines that regulation of indoor air quality is warranted, the health complaints related to poor indoor air quality may be significantly reduced in a cost effective manner by adopting ventilation rates such as those specified in the American Society of Heating, Refrigerating and Air Conditioning Engineers[11] (ASHRAE) Standard 62-1989, "Ventilation for Acceptable Indoor Air Quality." ASHRAE Standard 62-1989 establishes minimum ventilation rates for various indoor settings in order to "control carbon dioxide and other contaminants with an adequate margin of safety,

11. ASHRAE is a standard setting group that develops voluntary consensus guidelines for building designers and contractors.

and to account for variations among people, varied activity levels, and a moderate amount of smoking." This Standard was approved in 1990 by the American National Standards Institute (ANSI). ASHRAE 62-1989 has been adopted by 12 states and by two major building code organizations in the United States, and is currently under consideration for adoption by the remaining national building code organizations. The Standard establishes a ventilation rate of 20 cubic feet of outside air per minute (cfm) per person for most commercial or office facilities, with 15 cfm as the minimum. The drafters of the Standard concluded that a minimum ventilation rate of 15 cfm/occupant will produce air quality that is acceptable to 70% of visitors and to 90% of occupants, assuming a moderate amount of smoking (30% smoking, 1.7 cigarettes/hour/smoker). See ASHRAE Standard 62-1989, "Ventilation for Acceptable Indoor Air Quality," Atlanta, ASHRAE Publications, 1989. Moreover, adoption of the ventilation rates in the current ASHRAE Standard would be consistent with OMB Policy Directive A-119 which instructs government agencies to look to consensus standards when establishing regulations.

The importance of adequate ventilation for achieving and maintaining acceptable indoor air quality should not be underestimated. Ventilation provides a comprehensive solution to

problems with indoor air quality. As building investigators from Healthy Buildings International have noted:[12]

> Smoke accumulation within offices may be only the tip of the iceberg. If smoke is trapped by bad ventilation so are all other indoor pollutants. Many of these invisible chemicals, dusts, fibers, bacteria and fungi can have acute or long term health effects on the building occupants . . . [R]eacting solely to the visible evidence of poor ventilation omits invisible pollutants and certainly does not address the fundamental problem of inadequate ventilation.

Scientific and technical literature suggests that compliance with ventilation rates specified in ASHRAE Standard 62-1989 will effectively minimize complaints about PTS and other substances in indoor air. For example, in 1990, researchers presented results of their work comparing the effects of increased ventilation recommended by ASHRAE 62-1989 in areas where smoking is permitted and in areas where it is prohibited. Through the aid of computer models, the researchers demonstrated that the quality of air in areas where smoking is permitted does not differ significantly from the quality of air in non-smoking areas, where

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12. "Factors Affecting Employee Health & Comfort: Tobacco Smoke Signals New Challenges for Managers," Healthy Buildings International, September/October, 1991: 2-5.

both areas are supplied with outside air at the level recommended by ASHRAE 62-1989.[13]

Scientific literature also reveals that increasing the rate of ventilation reduces levels of radon in indoor air. In their study of the reduction of indoor air concentrations of radon, Jonassen and McLaughlin wrote that:

> [T]he most effective way of reducing the activity concentrations of radon and its progeny in the room air is ventilation. Ventilation with radon free (or radon poor) air will, of course, reduce the concentrations of the daughter products directly by dilution.[14]

Not only will compliance with ventilation rates such as those in ASHRAE Standard 62-1989 help to achieve and maintain acceptable air quality in the workplace, but this goal can be accomplished cost effectively. Indeed, if state-of-the-art technology is employed in the design and operation of HVAC systems, ventilation rates at or above those specified by ASHRAE 62-1989 may be provided at reduced operating and energy costs, compared to

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13. Pedelty, J. and Holcomb, L., "A Computer Simulation of Indoor Air Quality Which Models Changes in Point Sources and Ventilation," Environ Technol Letters 11: 1053-1062, 1990.

14. Jonassen, N. and McLaughlin, J.P., "The Reduction of Indoor Air Concentrations of Radon Daughters Without the Use of Ventilation," The Science of the Total Environment 45: 485-492, 1985.

the operation of traditional systems.[15] However, even in those instances where existing HVAC equipment is operated to deliver ventilation rates in accordance with all specifications in ASHRAE 62-1989, estimates of increased operating costs typically range from only 1% to 8%. Research suggests that even these costs would be offset by the benefits of improved productivity and reduced absenteeism that result from adequate ventilation.[16] In fact, some researchers have argued that the cost of absenteeism attributable to poor indoor air quality greatly exceeds any increased energy expenditures related to compliance with ASHRAE Standard 62-1989.[17] (See Responses to Questions 45, 48, 49, 66, 71, 75a and 85a.)[18]

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15. Electric Power Research Institute, Cold Air Distribution Design Guide, EPRI EM-5730 Project 2732-3, Final Report, March 1988.

16. Goodfellow, H. and J. Wyatt, "Critical Review of Ventilation Contaminants in indoor Air," Indoor Air Quality and Ventilation, ed. F. Lunau, London, Selper Ltd.: 95-104, 1990.

17. The Sheet Metal and Air Conditioning Contractor's National Association, Statement on H1066 "The Indoor Air Quality Act of 1991" to The House Science, Space and Technology Committee, Environment Subcommittee, May 9, 1991; Miller, R., Indoor Air Quality, (Norcross, GA., S.E.A.I. Technical Publications, 1991), 145; Binnie, P., "The Role of Ventilation in Controlling the Quality of Indoor Air, Including ETS," Other People's Tobacco Smoke, ed. A. Armitage, (East Yorkshire (U.K.), Galen Press 1991): 159-172.

18. See Philip Morris' response to RFI Question No. 92 which outlines the elements recommended for regulatory action on indoor air quality, should OSHA determine to promulgate an IAQ standard.

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V. CONCLUSION

We believe the scientific data demonstrate that typical exposures to PTS in the workplace are minimal (See Responses to Questions 24, 35-38), that PTS plays a minor role in "sick-building syndrome" (See Response to Question 3) and that ventilation rates such as those prescribed in ASHRAE Standard 62-1989 result in the maintenance of acceptable indoor air quality in general, including the dilution and removal of PTS and other indoor air constituents (See Responses to Questions 49, 62, 66, 71). There is a significant body of scientific literature which suggests that exposure to chemical agents, radon and bioaerosols in the indoor environment is associated with complaints and possible adverse health effects. Taken together, these data suggest that a focus on PTS in an attempt to address poor indoor air quality would be misdirected and inadequate. In fact, prohibition of smoking would not have affected indoor air quality problems in 95-98% of the building investigations reported to date.

The available data from published epidemiologic studies are not sufficient to support the claim that PTS exposure is associated with chronic disease in nonsmokers. Moreover, virtually all of the published epidemiologic studies that have attempted to address workplace exposure to PTS failed to report a significant

increased risk of chronic disease in nonsmokers associated with PTS exposure in the workplace.

Thus, to the extent that OSHA determines that a need exists for regulatory action, it is recommended that OSHA frame its regulations in terms of an overall performance standard which will address inadequate ventilation, rather than through efforts to control each specific substance that may be found in indoor air. To this end, the ventilation rates set forth in ASHRAE Standard 62-1989 stand as the most commonly recognized ventilation standard designed to address complaints about indoor air quality. Consideration of this Standard by OSHA is consistent with OMB Policy Directive A-119 which instructs federal regulatory agencies to consider existing consensus standards and guidelines in addressing regulatory issues. Thus, if OSHA determines regulatory action is warranted, adoption of ventilation rates at least equivalent to those set forth in a general consensus standard like ASHRAE 62-1989 would constitute a well-reasoned approach that has been scientifically shown to improve indoor air quality and, at the same time, would allow employers flexibility in accommodating the wishes of their diverse workforces.